CLAIMS

1. A method of performing communication in a two-hop wireless communication network, wherein a base station (410), at least one mobile station (420) and a plurality of relay station (415) are engaged in, or in the process of establishing, a communication session, and wherein the relay stations (415) forwards signals from the based station (410) to the at least one mobile station (420), **characterised in** that the method comprises the step of:
   - the at least one mobile station (420) establish soft association to a plurality of relay stations (415) by internally *selecting* (805) a set of relay channels from a plurality of relay stations (415) with at least partially overlapping coverage, said set of relay channels associated to relay stations (415) being candidates for use in the communication session.

2. The method according to claim 1, **wherein** the step of selecting (805) comprises the substep of:
   -the mobile station (420) *measures* (1405) the relay channel quality of a plurality of the relay stations (415) with at least partially overlapping coverage.

3. The method according to claim 2, **wherein** in the step of measuring (1405) the mobile station measures on pilots sent by the at least one relay station (415).

4. The method according to claim 2, **wherein** in the step of measuring (1405) the mobile station measures on pilots sent by the basestation (410) and forwarded by the at least one relay station (415).

5. The method according to any of claims 2-4, **wherein** the step of selecting (805) comprises the further substep of:
   -the mobile station 420 *determines* (1410) bandwidth requirements based on a current application executed in the mobile station or anticipated future applications; and said selection is based both on the relay channel quality measurements and the bandwidth requirements.

6. The method according to any of claims 1 to 5, **wherein** the step of selecting (805) is repeated during the communication session in order to adapt to changing conditions in the radio environment.

7. The method according to any of claims 1 to 6, **wherein** the method comprises the further steps of:
- at least one mobile station (420), on establishing or during the communication session, *feeding back* (835) information on the set of soft associated relay stations (415) to the base station (410); and
-the base station (410) *adapting* (810) the transmission to the relay stations (415) which the mobile station (420) has soft association with, at least partly in response to the feedback.

8. The method according to any of claims 1 to 7, **wherein** the method comprises the further steps of:
- at least one mobile station (420), during the communication session, *feeding back* (835) information on the communication quality to the base station (410); and
-the base station (410) further *adapting* (810) the transmission to at least one of the relay stations (415) which the mobile station (420) has soft association with, in response to the communication quality feedback from the at least one mobile station.

9. The method according to claim 7 or 8, **wherein** the step of the base station adapting (810) the transmission comprises the further substeps, to be performed by the base station (410), of:
-*identifying* (810:1) from the feedback conflicting demands from at least two mobile stations (420) regarding the usage of at least one relay station (415), said two mobile stations (420) having soft association to the same at least one relay station (415);
-*initiating* an optimization process (810:2) for resolving the conflicting demands;
-*adapting* (810:2) the transmission at least to the relay stations to which the two mobile stations have soft association, taking into account the result of the optimization process (810:3).

10. The method according to claims 8 or 9, **wherein** the step of feedbacking (805) comprises that the mobile station feeds back raw channel state information to the base station (410).

11. The method according to claims 8 or 9, **wherein** the step of feedbacking (805) comprises that the mobile station feeds back processed channel state information to the base station (410).

12. The method according to claim 11, **wherein** the step of feedbacking (805) comprises that the mobile station feeds back any of, or any combination of, the following preferred parameters to the base station (410): link mode, coding scheme, modulation scheme and antenna transmit weights.

13. The method according to any of claims 1 to 12, **wherein** the method comprises MIMO based communication between the transmitter (520) and the relay stations (415).

14. The method according to claim 13, **wherein** the transmitter of a base station (410) sends a vector **T** over channel matrix **H**, where each row of the matrix **H** corresponds to one or more relay stations (415) using the same forwarding relay channel, and the matrix **H** comprises as many rows as there are relay forwarding channels.

15. The method according to claim 13, **wherein** the transmitter of a base station (410) sends a vector **T** over channel matrix **H**, where each row of the matrix **H** corresponds to one or more relay stations (415) using the same forwarding relay channel, and there are at least two forwarding relay channels.

16. The method according to claim 13, **wherein** the transmitter of the base station (410) uses singular value decomposition (SVD) of the channel matrix **H** and applies a unitary weight matrix **(U)** to the outputted signal to facilitate a diagonalization with the use of the Hermitian of a unitary weight matrix **(V)**.

17. The method according to claim 13, **wherein** singular value decomposition (SVD) is used and the method comprises the steps of:
-the transmitter of a base station (410) sending a vector **T** over channel matrix **H**, where each row corresponds to one or more relay stations (415)

using the same relay channel and there are as many relay channels as there are rows in the channel matrix, and applying a unitary weight matrix (**U**) to the outputted signal;
-the receiver performing a diagonalization by multiplying the received signal with the Hermitian of a unitary weight matrix **V**, whereby the receiver is able to directly receive a number of parallel substantially self-interference free MIMO subchannels.

18. The method according to any of claims 1 to 17, **wherein** the method of performing communication is preceded by a process of organizing relay stations (415) so that the channels of at least two neighbouring relay stations (415) are essentially orthogonal and the coverage of the at least two neighbouring relay stations are arranged to have substantial overlap.

19. The method according to claim 18, **wherein** the overlap between the two neighbouring relay stations is above 10% of the coverage area of the relay station exhibiting the smallest coverage area.

20. A system adapted for communication in a two-hop wireless communication network, wherein the network comprises at least a base station (410), at least one mobile station (420) and a plurality of relay stations (415), wherein the relay stations (415) are adapted to forwarding signals from the base station (410) to the mobile station (420), **characterised in** that
-at least a portion of the plurality of relay stations (415) are organized so that at least two neighbouring relay stations (415) have substantially overlapping coverage, and the channels of the relay stations (415) with overlapping coverage are essentially orthogonal; and in that
- at least one mobile station (420:1) is arranged to select a set of relay stations (420) from the relay stations (415) with at least partially overlapping coverage, whereby establishing soft association to a plurality of relay station (415) which are candidates to use in communication between the base station (405) and the mobile station (420).

21. The system according to claim 20, **wherein** a plurality of mobile stations (420) are arranged to select individual sets of relay stations from the portion of relay stations (415) with at least partially overlapping coverage.

22. The system according to claim 20 or 21, **further characterized** in that the forwarding performed at the relay stations (415) during a communication session is not essentially dependent on control signaling directly between the mobile stations (420) and the relay stations (415).

23. The system according to any of the claims 20 to 22, **further characterized** by logical feedbacks (550) between the mobile stations (420) and the base station (410), wherein the logical feedbacks carries information usable by the base station (410) to adapt transmit parameters for the transmission to the relay stations (415).

24. The system according to claim 23, **wherein** in the logical feedback carries information on the set of soft associated relay stations (415) for each mobile station (420).

25. A receiver (520) adapted for use in a two-hop wireless communication network, wherein the network comprises a transmitter (510), the receiver (520) and at least one relay station (415), wherein the relay station (315) is adapted to forwarding signals from the transmitter (510) to the receiver (520) **characterised in** that the receiver (520) is provided with:
-selecting means (524) adapted for selecting a set of relay stations (425) from a plurality of relay stations (415) with substantially overlapping coverage, said selecting means arranged to base the selection on relay channel quality;
-feedbacking means (523) adapted for feedbacking the information on selected relays to the transmitter (510).

26. The receiver according to claim 25, **wherein** the feedbacking means comprises means for feeding back raw channel state information for each relay channel to the transmitter (510).

27. The receiver according to claim 25, **wherein** the feedbacking means comprises means for feeding back processed channel state information for each relay channel to the transmitter (510).

28. A base station (410) adapted for use in a two-hop wireless communication network, wherein the network comprises a base station (410), at least one mobile station (420) and at least one relay station (415), wherein the relay station (315) is adapted to forwarding signals from the base station (410) to

the mobile station (420), the base station (420) comprising means for receiving feedback from the mobile station on the transmission to the mobile station, **characterised in** that the base station (420) is provided with:
-optimization means (515) adapted for identifying conflicting demands from at least two mobile stations (420) regarding the usage of at least one relay station (415), said two mobile stations (420) having soft association to the same as least one relay station (415), and adapted for performing an optimization process for resolving the conflicting demands;
- transmission parameter adapting means (514) adapted for determining transmission parameters for the transmission at least to the relay stations to which the two mobile stations have soft association, taking into account the result of the optimization process.

29. The base station (410) according to claim 28, **wherein** the transmitter of the base station (410) is adapted to perform MIMO based communication and sending a vector **T** over channel matrix **H**, where each row of the matrix **H** corresponds to one or more relay stations (415) using the same relay channel and there are as many relay channels as there are rows in the channel matrix.

30. The base station (410) according to claim 29, **wherein** the transmitter of the base station (410) is adapted for using singular value decomposition (SVD) and apply a unitary weight matrix (**U**) to the outputted signal to facilitate a diagonalization with the use of a Hermitian of a unitary weight matrix (**V**).